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APPLICATION FOR LETTERS PATENT

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FOR

# A THERMOFORMABLE FILM LAMINATION CONTAINING A FLEXIBLE POLYAMIDE COEXTRUSION

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This application claims the benefit of U.S. Provisional Application No. 60/199,674 filed on April 21, 2000.

## Field and Background of the Invention

This invention relates generally to a flexible packaging film construction that contains a biaxially oriented polyester film, an adhesive and a flexible polyamide-containing coextruded film. In addition, this invention relates to a package prepared from a biaxially oriented polyester film, an adhesive and a flexible polyamide-containing coextruded film.

It is common practice to package articles such as food products in multilayer films or laminates to protect the packaged product from abuse and exterior contamination. The multilayer films or laminates provide convenient and durable packages for transportation and ultimate sale to the end user.

It is usual to include printed indicia like decorations and text on packaging films. A desirable aspect of a printed package requires the printed image to repeat identically from one package to the next. This requires the printed image and the package dimensions to coincide exactly over many iterations. When this successfully occurs, the print is deemed to be in register. It is convenient to include a dimensionally stable film like biaxially oriented polyester in the construction of a printed package. Such a film resists elongation through the various manufacturing processes used to produce a film construction and finished package. This resistance to elongation greatly benefits registration control.

Certain package styles are created by a technique known as thermoforming. In this instance, the film is shaped into a cavity by softening the film via thermal exposure and drawing

the softened film into a mold. This package style is commonly used to contain items like processed meat. Film constructions engineered to accommodate thermoforming do not often include biaxially oriented films. The resistance to elongation of biaxially oriented films makes them especially difficult to thermoform. Beyond the formation of very shallow cavities, thermoformed articles that include biaxially oriented films tend to encounter defects like holes and poor definition of shape. Still, there exists limited use of oriented films in end uses that require the formation of very shallow cavities. These applications profit from the ability to easily and repetitively print the films such that the indicia on the packages are in register. It is desirable to extend the use of biaxially oriented films to include the manufacture of register printed packages with deeper thermoformed cavities.

**Summary of the Invention**

This invention offers an improvement in the thermoforming performance of a register printed packaging film. The thermoformability of our packaging film construction that includes a biaxially oriented polyester film is substantially improved by also including a flexible polyamide-containing coextruded film. Simultaneous with the thermoforming improvement, the film offers excellent control of print registration.

The flexible polyamide-containing coextruded film contains at least one semi-crystalline polyamide layer. That layer may include polyamides such as nylon 6, nylon 66, nylon 6,66, and the like. Additionally, it may be prepared from a blend of a semi-crystalline polyamide and an amorphous polyamide. The blend is 80 to 90 % by weight of the semi-crystalline polyamide and 10 to 20 by weight of the amorphous polyamide. The coextruded film may also contain first and second flexible polyamide layers that are immediately separated by an oxygen barrier layer. The oxygen barrier layer is preferably comprised of an ethylene vinyl alcohol copolymer.

## Brief Description of the Drawing

Figure 1 is a cross-sectional view of a multilayer film assembly of the present invention consisting of a biaxially oriented polyester film layer, an ink layer, an adhesive layer and a sequence of layers formed from a flexible polyamide-containing coextrusion.

## Detailed Description of the Preferred Embodiment

Referring to the drawing there is illustrated a multilayer film assembly that is suitable for the fabrication of a register printed, thermoformable package. A biaxially oriented polyester (OPET) layer 16 is printed with suitable ink 15. An example of a preferred biaxially oriented polyester film is MYLAR® 75 P25T available from DuPont Teijin Films. A suitable ink is represented by the Color Converting Industries' trade name AXL®.

In a manufacturing operation separate from the printing step described immediately above, a multilayer coextruded film is prepared. A preferred multilayer film coextrusion has at its core an ethylene vinyl alcohol copolymer (EVOH) barrier layer 11. An example of the barrier layer core is SOARNOL® ET supplied by Noltex. Disposed on either side of the barrier layer core are layers 10a and 10b comprised of a flexible polyamide. The flexible polyamide is preferably prepared from a blend of 85 % by weight of a semicrystalline polyamide and 15 % by weight of an amorphous polyamide. An example of a suitable semicrystalline polyamide is a nylon 6 polymer supplied by BASF known as ULTRAMID® B36. A suitable amorphous polyamide is nylon 616T, produced by DuPont as SELAR® PA 3426. Simultaneously extruded with the barrier core layer 11 and the flexible polyamide layers 10a and 10b are tie layers 12a and 12b and polyolefin layers 13a and 13b. Tie layers are used to join flexible polyamide layers 12a and 12b to polyolefin layers 13a and 13b. Appropriate tie layer materials include maleic

anhydride-grafted polyolefins, wherein the grafted polyolefins include those based on ethylene vinyl acetate copolymer, polypropylene, low density polyethylene, high density polyethylene and ethylene alpha-olefin copolymers. A commercially available example of a suitable maleic anhydride-grafted polyolefin is supplied by Rohm and Haas as TYMOR®1 N05. In a preferred version, tie layers 12a and 12b are comprised of a blend of 20%
by weight of Rohm and Haas TYMOR®1 N05 and 80 % by weight of an ethylene alpha-olefin copolymer. One such suitable ethylene alpha-olefin copolymer is ATTANE® 4201 supplied by the Dow Chemical Company. Joined to the tie layers 12a and 12b are polyolefin layers 13a and 13b. The polyolefin layers may be composed of polypropylene, low density polyethylene, high density polyethylene, ethylene alpha-olefin copolymers, ethylene ester copolymers like ethylene vinyl acetate copolymers or ethylene methyl acrylate copolymers, ethylene acid copolymers like ethylene acrylic acid copolymers or ethylene methacrylic acid copolymers, ionomers and the like. An example of suitable polyolefin layers 13a and 13b in this embodiment include those comprised of an ethylene alpha-olefin copolymer like Dow ATTANE® 4201 (ULDPE). Layers 13a and 13b are advantageously modified with an antiblocking agent, slip agents and a processing aid. In this example, a suitable antiblocking agent is supplied as a concentrate of 20 % by weight diatomaceous earth in low density polyethylene by Ampacet as grade 10063. This concentrate is added to the Dow ATTANE® 4201 at 3.5 % by weight. A suitable slip agent is supplied as a concentrate of 4 % erucamide and 2° stearamide in low density polyethylene by Ampacet as grade 10061. This concentrate is added to the Dow ATTANE® 4201 at 2.0 % by weight. A suitable processing aid is supplied as a concentrate of 3 % of a copolymer of hexafluoropropylene and vinylidene fluoride in linear density polyethylene by Ampacet as grade 10562. This concentrate is added to the Dow

ATTANE® 4201 at 0.3 %.

Further, to produce the composition given by example in Figure 1, the printed biaxially oriented polyester film, layers 15 and 16, are joined to the multilayer coextruded film, layers 13b, 12b, 10b, 11, 10a, 12a and 13a by an adhesive layer 14. An appropriate adhesive layer is produced from the combination of an isocyanate-terminated polyester and a polyol. The preferred joining technique is known in the art as dry bond adhesive lamination. An example of an appropriate adhesive is supplied by Rohm and Haas as ADCOTE® 522.

Although we have only illustrated the compositions of layers 13a and 13b as having additives, it is understood that all of the compositions for the various layers can have additives such as slip agents, processing aids, antiblocking agents, antistatic agents, colorants, etc. Also, even as the aforementioned example is an embodiment of the invention, it is important to understand that the intent of the invention is to combine a biaxially oriented film with a flexible polyamide-containing multilayer coextrusion. The important result of this combination is to substantially improve the thermoformability of a register-printed flexible packaging film. Various features of the invention have been particularly shown and described concerning the illustrated embodiment of the invention. However, it must be understood that this particular arrangement does not limit, but merely illustrates, and the invention is to be given its fullest interpretation within the terms of the appended claims.